



First records of *Hydrocotyle itatiaiensis* Brade (Araliaceae) in the state of Paraná, southern Brazil

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Abstract. Despite the existence of important floristic and forest inventories in the Paraná state, the montane and upper montane ecosystems still give rise to new species and new records of plants. Here, we report for the first time in the Paraná state *Hydrocotyle itatiaiensis* Brade (Araliaceae), a rare and poorly studied species endemic to montane and upper montane rainforests and highland grasslands of the South and Southeast regions of Brazil. The previously known geographic distribution had a 700 km gap between northern São Paulo and southern Santa Catarina states, which is now filled by the present record. We provide photographs from the field, a map of occurrences, a description, and comments on the morphology, taxonomy, and conservation status of the species. Our new records reinforce the conservation importance of these environments and the need for further floristic surveys in the region.

Keywords. Atlantic Rainforest, cloud forest, highland grasslands, Serra do Mar

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Introduction

Hydrocotyle Tourn. ex L. is a widely distributed genus, comprising approximately 130 species with tropical and temperate distributions (Perkins 2020). In Brazil, there are 21 species, of which 10 are endemic (Fiaschi and Nery 2023), while 10 species are known in Paraná state (Fiaschi 2014). Traditionally treated within Apiaceae, *Hydrocotyle* was transferred to Araliaceae after phylogenetic evidence (Plunkett et al. 2004). *Hydrocotyle* is characterized by the herbaceous life form, with stoloniferous, creeping, or underground stems, non-invaginated petioles, an absent sheath, simple to compound leaves, the presence of stipules, and multiflorous umbels (Corrêa and Pirani 2005; Souza and Lorenzi

2012; Fiaschi and Nery 2023). Some of its species hold economic and cultural importance and are cultivated as ornamental plants for groundcover, aquarium decoration, and medicinal purposes, which has led to problems caused by the introduction of alien species (Wanderley et al. 2005; Irsyam et al. 2022).

Hydrocotyle species usually occur in aquatic or wet environments (Ruiz-Avila and Klemm 1996). In South America, there is a greater diversity of the *Hydrocotyle* species in the Andes and mountain areas in the Atlantic Forest along south and southeastern Brazil (Mathias and Constance 1951; Fiaschi 2018; Nery and Fiaschi 2019; Nery et al. 2020). However, there are still several knowledge gaps in species diversity and basic biology for many of these heterogeneous ecosystems in

southern and south-eastern Brazil (Falkenberg and Voltolini 1995; Martinelli 2007).

Usually, the environmental conditions of montane and upper montane forests and grasslands result in the simplification of the community when compared to lower-altitude formations (Stadtmüller 1987). Despite the harsh conditions, such environments harbor an important number of endemic and endangered species (Bruijnzeel and Hamilton 2000; Iganci et al. 2011). Recent studies reported the occurrence of *Hydrocotyle alpina* Vell., *H. itatiaiensis* Brade, and *H. leucocephala* Cham. & Schltdl. in high-altitude vegetation of the Serra da Mantiqueira in the southeastern Brazil (Meireles et al. 2014), while in Paraná and Santa Catarina states in southern Brazil, only *H. alpina* (previously identified as *H. quinqueloba* Ruiz & Pav.) and *H. langsdorffii* DC. have been recently reported in upper montane forests and grasslands of Serra do Mar (Mathias et al. 1972; Mocochinski and Scheer 2008; Scheer and Mocochinski 2009; Martin-Ramos et al. 2011; Nery et al. 2020).

During floristic studies conducted at the Pico Caratuva, collection efforts led to the location of *H. itatiaiensis* in Paraná's Serra do Mar Mountain range. We report this species for the first time from Paraná state, and this new record fills a gap of more than 700 km between areas of its disjunct distribution. We also provide field photos and notes contributing to the knowledge of the species biology and distribution.

Methods

A floristic survey was carried out from April 2019 to December 2022 at Pico Caratuva, which is located in the Parque Estadual Pico Paraná. The area surveyed at Pico Caratuva is a montane and upper montane cloud forest. The site is part of the Serra do Ibitiraquire, whose mountains reach the highest altitudes in southern Brazil, up to 1877 m above sea level (Maack 2012). The local climate is classified as Cfb, according to Köppen's classification system, without a defined dry season, mean temperature of the coldest month below 18 °C and above -3 °C, and mean temperature of the warmest month below 22 °C (Alvares et al. 2013). However, temperatures in these mountains can reach minimums of -5 °C (Roderjan and Grodzki 1999).

The collected specimens were herborized according to Fidalgo and Bononi (1984) and deposited at the Herbario Escola de Florestas Curitiba (EFC; herbaria acronyms according to Thiers 2023). The identification was carried on with specialized literature (Corrêa and Pirani 2005; Fiaschi and Nery 2023), the original description (Brade 1946), and comparison with other vouchers through speciesLink network (2023) and Herbário Virtual REFLORA (2023). The collections from the Museu Botânico Municipal de Curitiba (MBM), EFC, and Herbário da Universidade Federal do Paraná (UPCB) were also checked for possible additional materials. The morphological terminology follows Gonçalves and

Lorenzi (2011). The vegetation was classified according to the Technical Manual of the Brazilian Vegetation (IBGE 2012). Geographical distribution was obtained from data available at the speciesLink network (2023), and the map was created using QGIS v. 3.16.11 (QGIS Development Team 2021).

Results

***Hydrocotyle itatiaiensis* Brade**, Rodriguésia 10(20): 44–45 (1946)

Figure 1

Type. BRAZIL – [Rio de Janeiro] Serra do Itatiaia, Planalto 2100 m alt.; III.1937; Brade, A.C. 15666; terrestre na mata; B 100247951.

New records. BRAZIL – Paraná • Campina Grande do Sul, Parque Estadual Pico Paraná, Pico Caratuva; 25°14'14"S, 049°50'08"W; 1490 m alt.; 30.IV.2019; I. Souza 401; EFC 17777 • ibid.; 25°14'11"S, 048°49'56"W; 1530 m alt.; 28.II.2022; I. Souza 1277; EFC 22452 • ibid.; 06.II.2010; E.D. Lozano 207; MBM 360394.

Identification. Creeping herb 5–15 cm tall; stem purple, glabrous to hirsute, rooting at nodes; stipules 1.0–1.5 × 1.5–3.0 mm, orbicular, purple. Petiole 5–10 cm long, villous, indumentum increasingly denser towards the apex, distal portion with larger trichomes; lamina 2.0–3.0 × 3.5–6.3 cm, reniform, hirsute, trichomes mainly along the veins, more abundant on the abaxial surface, lobes 7, apex apiculate, margin crenate. Umbel simple, with 25–40 flowers, bracts purple, peduncle 6–15 cm long, villous, indumentum increasingly denser towards the apex. Flowers purple, ca. 2 mm in diameter, pedicel ca. 5 mm long, calyx lobes inexpressive, petals ca. 1.0 × 0.5 mm, ovate-lanceolate, glabrous, apex acute, stamens 1 mm long, stylopodium evident, ca. 0.6 mm wide, green, styles 0.3 mm long. Fruits purple, 2.0 × 1.2 mm, pedicel 5–8 mm long, laterally flattened, transversely elliptical, slightly ribbed.

The species can be easily identified by the reniform, 7-lobed leaves, with seven primary veins, umbel with 30–50 flowers, and purple flowers and fruits. The morphologically similar taxa *H. leucocephala* Cham. & Schltdl. and *H. callicephala* Cham & Schltdl. can be distinguished, respectively, by the white flowers, white-green fruits and 7–10 primary veins, and by pale-green flowers, green fruits, and 7–9 primary veins (Corrêa and Pirani 2005; Fiaschi and Nery 2023). Where it was collected, it occurs along with *H. alpina*, which differs by the peltate leaves, with 4–5 primary veins, white flowers and green fruits (Corrêa and Pirani 2005; Mocochinski and Scheer 2008; Scheer and Mocochinski 2009; Fiaschi and Nery 2023).

Distribution. The species is endemic to Brazil, occurring in the slopes of the Serra do Itatiaia, Serra da Mantiqueira, Serra da Bocaina, and the Aparados da Serra region of Serra Geral, in the states of Rio de Janeiro, Minas Gerais, Santa Catarina, and São Paulo (Fig. 2), at altitudes of 1600–2200 m a.s.l., comprising montane

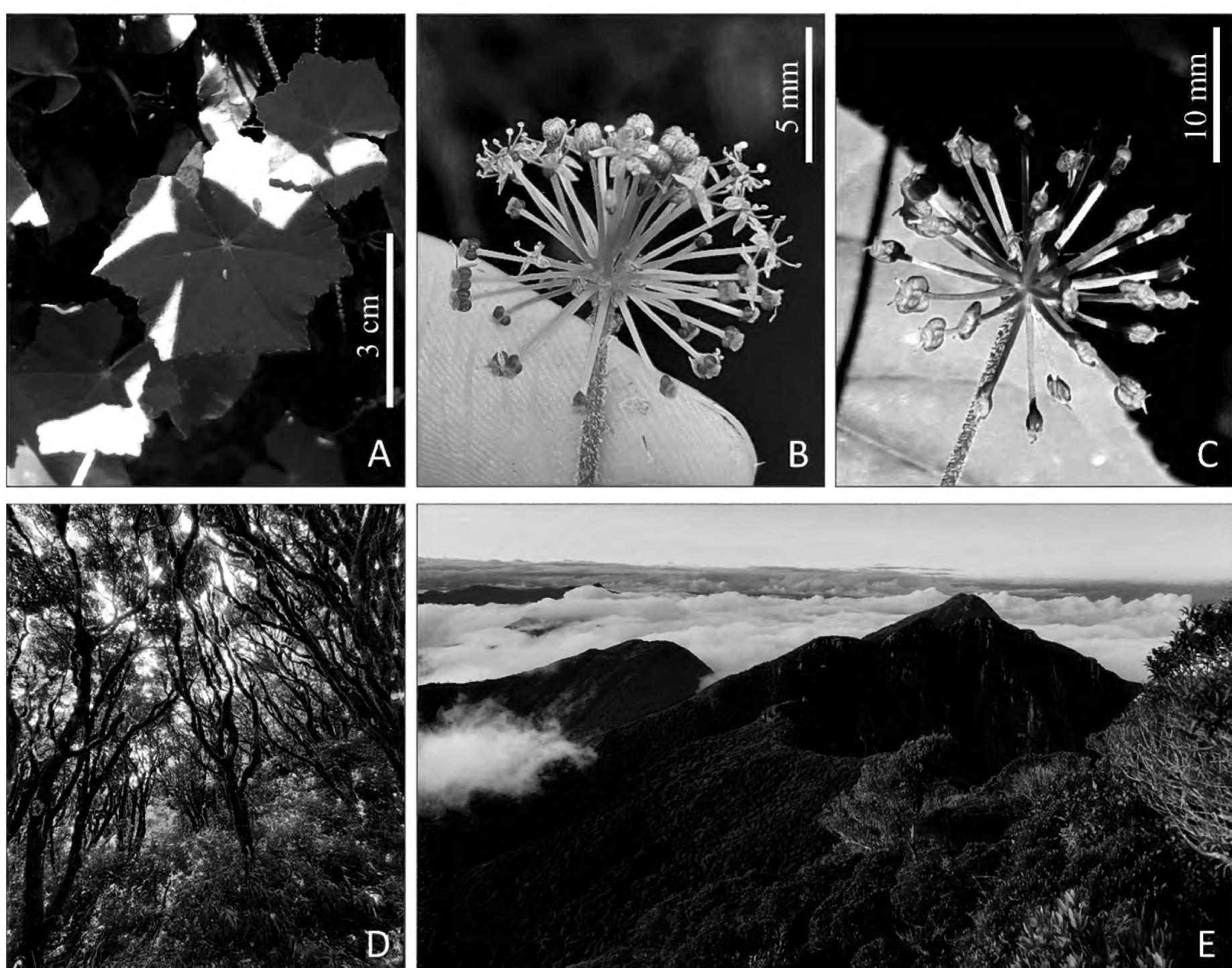


Figure 1. *Hydrocotyle itatiaiensis* Brade. **A.** Leaves. **B.** Umbel with floral buds, flowers, and young fruits. **C.** Umbel with fruits. **D.** Upper montane rainforest. **E.** Serra do Ibitiraquira seen from the Pico Caratuva.

and upper montane rainforests and highland grasslands (Brade 1946, 1948, 1951; Falkenberg and Voltolini 1995; Corrêa and Pirani 2005; Boldrini et al. 2009; Meireles et al. 2014). In Paraná, it was found at the Pico Caratuva, Serra do Ibitiraquira, at around 1500 m a.s.l., in the upper montane rainforest (the so-called “matinha nebular”) and transition areas with montane rainforest (Fig. 1D). Another population was found at the Pico Taipabuçu, in the same mountain range, at 1650 m a.s.l., but only sterile individuals were seen.

Phenology. Flowering and fruiting year round (Corrêa and Pirani 2005). In Paraná, it was collected with floral buds and flowers in February, and with fruits in April.

Conservation status. Currently, the species is not regionally or federally protected in Brazil, and it has not been evaluated according to IUCN criteria. The observed populations were locally abundant but occurred in very specific points along the trails of the Parque Estadual Pico Paraná. Local threats are mostly forest fires, which could greatly impact the local ecosystem and camping activities (common in the protected area). In addition to occurring in the Parque Estadual Pico Paraná, the species also occurs in other protected areas, such as the Parque Nacional de São Joaquim,

Parque Nacional do Itatiaia, Parque Nacional Serra da Bocaina, and Parque Estadual Campos do Jordão.

Discussion

Hydrocotyle itatiaiensis was described from the Itatiaia highlands (Brade 1946), and floristic surveys found populations in the Serra da Mantiqueira (Brade 1948) and in forests with *Podocarpus* sp. at Serra da Bocaina (Brade 1951). In Santa Catarina, it was first collected by Reitz 3478 (RB 00689127) in 1956, and in São Paulo it was also found in Campos do Jordão, Campos da Bocaina, and Pindamonhangaba (Corrêa and Pirani 2005). Additional specimens were recently collected at Urubici region in Santa Catarina by Fiaschi 4077 (FLOR 51370), Funez and Hassemer 5245 (FURB 51091), and Souza et al. 1887 (FLOR 35932), but there were no records of this species in the portions of the Serra do Mar in Paraná and southern São Paulo, which, prior to our new record, left a gap of more than 700 km gap between records) (Fig. 2).

In the Aparados da Serra region, *H. itatiaiensis* is rare, exclusive to the “matinha nebular” (cloud forest), and is associated with wetlands (Boldrini et al. 2009) and occurring with *Gunnera manicata* Linden ex Delchev., *Eryngium smithii* Mathias & Constance, and

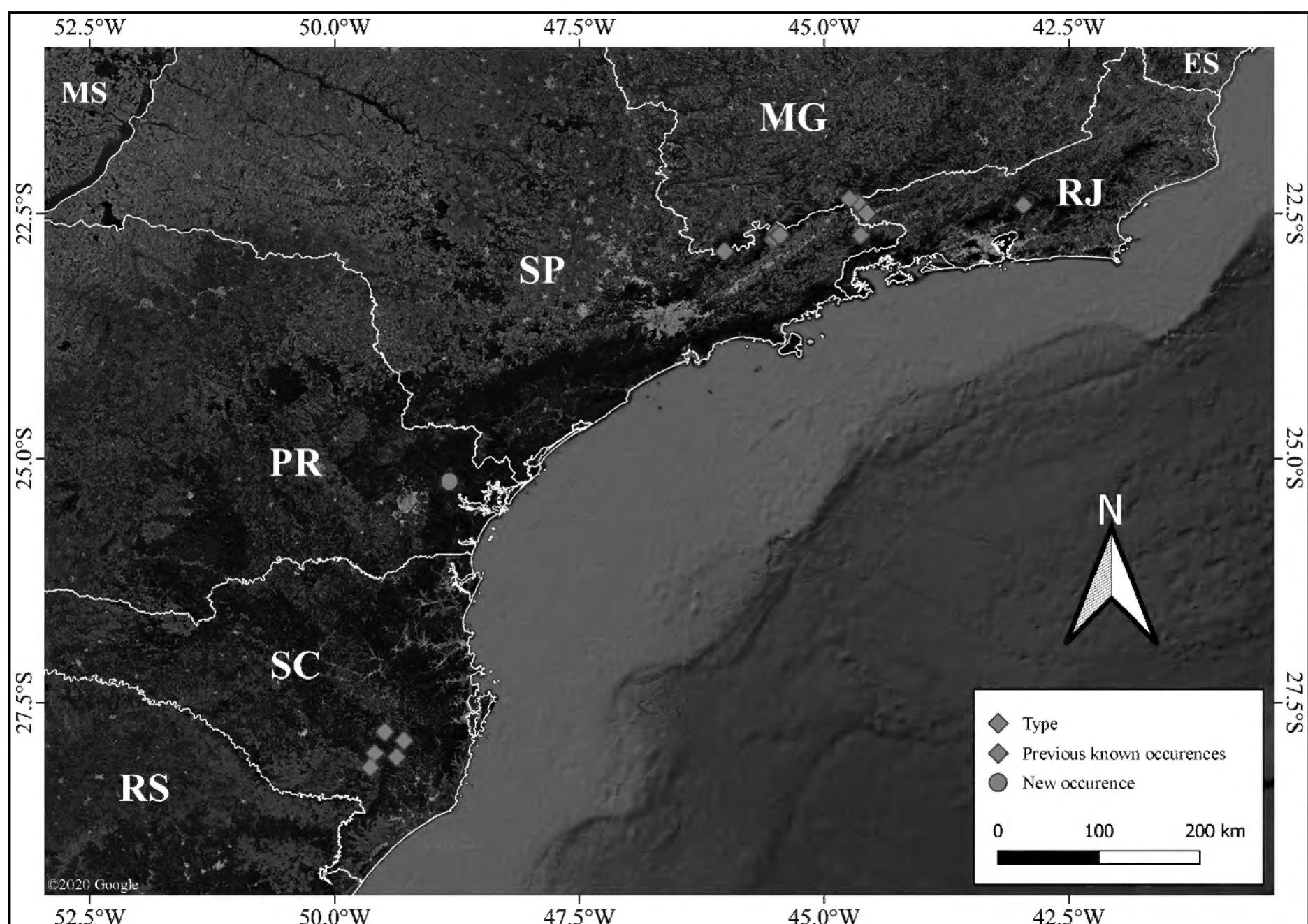


Figure 2. Geographical distribution of *Hydrocotyle itatiaiensis* Brade.

Leandra luctatoris Wurdack (Falkenberg and Voltolini 1995). Indeed, it was found in Paraná along a river patch and other microhabitats in a cloud forest environment. Such vegetation is known for the high humidity provided by the contact of clouds with vegetation (Bruijnzeel and Proctor 1995). Despite the large geographical range, its occurrence is environmentally restricted, and data from herbaria do not include records after 2017 in Rio de Janeiro, 2016 in Santa Catarina, 2002 in Minas Gerais, and 2000 in São Paulo, which suggests that it is, indeed, a rare species.

The present area occupied by upper montane rainforest and highland grasslands along the Brazilian Atlantic coast is very small. As an example, high-altitude grasslands cover less than 1% of the Atlantic Forest Biome (Fundação SOS Mata Atlântica and INPE 2021). However, during the Late Pleistocene and Late Glacial periods (around 50000–14000 years B.P.) until the early Holocene (around 6000 years B.P.), the colder climate allowed southern and southeastern grasslands to cover larger areas, connecting these localities (Behling 2002) and functioning as a dispersion route for the species. Present climate conditions are more favorable to the growth and thriving of tropical forests (Behling 2002), and these cold-adapted lineages are now restricted to the highlands and mountain ranges.

While collection efforts in nearby mountains still lead to the discovery of new species (Inácio et al. 2022; Silva et al. 2022) and occurrence records (Souza et al.

2019; Brotto and Völtz 2021; Ríos and Cruz 2021; Souza 2021), the conservation of these environments is essential to preserve its richness of species, many of which are endemic and endangered (Iganci et al. 2011; Külkamp et al. 2018). We emphasize the need to study these environments more thoroughly (Scheer and Mocochinski 2009).

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Authors' Contributions

Conceptualization: IS. Project administration: IS. Data curation: IS. Supervision: CTB. Resources: CTB. Writing – original draft: IS. Writing – review and editing: CTB, MBS, PH.

References

- Alvares CA, Stape JL, Sentelhas PC, de Moraes Gonçalves JL, Sparovek G (2013) Köppen's climate classification map for Brazil. Meteorologische Zeitschrift 22 (6): 711–728. <https://doi.org/10.1127/0941-2948/2013/0507>

- Behling H** (2002) South and southeast Brazilian grasslands during Late Quaternary times: a synthesis. *Palaeogeography, Palaeoclimatology, Papaeoecology* 177: 19–27. [https://doi.org/10.1016/S0031-0182\(01\)00349-2](https://doi.org/10.1016/S0031-0182(01)00349-2)
- Boldrini II, Eggers L, Mentz LA, Miotto STS, Matzenbacher NI, Longhi-Wagner HM, Trevisan R, Schneider AA, Setúbal RB** (2009) Flora. In: Boldrini II (Ed.) *Biodiversidade dos campos do planalto das araucárias*. Ministério do Meio Ambiente, Brasília, Brazil, 39–94.
- Brade AC** (1946) Espécies novas da flora do Brasil. *Rodriguésia* 10 (20): 41–46.
- Brade AC** (1948) Relatório de uma excursão ao município de Passa Quatro, estado de Minas Gerais. *Rodriguésia* 11 (12): 133–143.
- Brade AC** (1951) Relatório da excursão à serra da bocaina, no estado de São Paulo, realizada pelo Naturalista A. C. Brade, de 18 de abril à 24 de maio de 1951. *Rodriguésia* 26: 55–66.
- Brotto ML, Völtz RR** (2021) New records of four tree species in the state of Paraná, southern Brazil: Canellaceae, Lauraceae, Melastomataceae, and Myristicaceae. *Check List* 17 (3) 859–872. <https://doi.org/10.15560/17.3.859>
- Bruijnzeel LA, Hamilton LS** (2000) Decision time for cloud forests. *IHP Humid Tropics Programme Series* 13. IHP-UNESCO, Paris, France, 41 pp.
- Bruijnzeel LA, Proctor J** (1995) Hydrology and biogeochemistry of tropical montane cloud forests: what do we really know? In: Hamilton LS, Juvik JO, Scatena FN (Eds.) *Tropical montane cloud forests*. Springer Ecological Studies, New York, USA, 38–78.
- Corrêa IP, Pirani JR** (2005) Apiaceae. In: Wanderley MGL, Shepherd GJ, Melhem TS, Martins SE, Kirizawa M, Giulietti AM (Eds.) *Flora Fanerogâmica do estado de São Paulo online*, vol 4. Fapesp, São Paulo, Brazil, 27–32.
- Falkenberg DB, Voltolini JC** (1995) The montane cloud forest in southern Brazil. In: Hamilton LS, Juvik JO, Scatena FN (Eds.) *Tropical montane cloud forests*. Ecological studies, vol. 110. New York, USA, 138–149. https://doi.org/10.1007/978-1-4612-2500-3_8
- Fiaschi P** (2014) Araliaceae. In: Kaehler M, Goldenberg R, Evangelista PHL, Ribas OS, Vieira AOS, Hatschbach GG (Eds.) *Plantas vasculares do Paraná*. Universidade Federal do Paraná, Curitiba, Brazil, 72.
- Fiaschi P** (2018) Check-list da ordem Apiales no estado do Mato Grosso do Sul, Brasil. *Iheringia, Série Botânica* 73: 127–130.
- Fiaschi P, Nery EK** (2023) Araliaceae. In: *Flora e funga do Brasil*. Jardim Botânico do Rio de Janeiro. <https://floradobrasil.jbrj.gov.br/FB5113>. Accessed on: 2023-02-17.
- Fidalgo O, Bononi VL** (1984) Técnicas de coleta, preservação e herborização de material botânico. Instituto de Botânica, São Paulo, Brazil, 62 pp.
- Fundação SOS Mata Atlântica, INPE** (2021) *Atlas dos remanescentes florestais da Mata Atlântica: período 2019–2020*. Fundação SOS Mata Atlântica, São Paulo, Brazil, 73 pp.
- Golçalves EG, Lorenzi H** (2011) *Morfologia Vegetal*. Instituto Plantarum, Nova Odessa, Brazil, 546 pp.
- IBGE** (Instituto Brasileiro de Geografia e Estatística) (2012) *Manual Técnico da Vegetação Brasileira: Sistema fitogeográfico, Inventário das formações florestais e camp-estres, Técnicas e manejo de coleções botânicas, Procedimentos para mapeamentos*. IBGE, Rio de Janeiro, Brazil, 271 pp.
- Iganci JRV, Heiden G, Miotto STS, Pennington RT** (2011) Campos de Cima da Serra: the Brazilian subtropical highland grasslands show an unexpected level of plant endemism. *Botanical Journal of the Linnean Society* 167: 378–393. <https://doi.org/10.1111/j.1095-8339.2011.01182.x>
- Inácio CD, Lozano ED, Antunes K, Báez-Lizarazo MR, Eggers L** (2022) Exploring *Sisyrinchium* (Iridaceae) diversity in the Atlantic Forest biome: three new species in *S. sect. Viperella*. *Phytotaxa* 541 (2): 153–164. <https://doi.org/10.11646/phytotaxa.541.2.5>
- Irsyam ASD, Hariri MR, Peniwidiyanti P, Al Anshori Z, Hutabarat PWK, Dewi AP, Irwanto RR** (2022) Five newly recorded alien species of *Hydrocotyle* Tourn. ex L. (Araliaceae) in Java, Indonesia. *Check List* 18 (4): 763–772. <https://doi.org/10.15560/18.4.763>
- Külkamp J, Heiden G, Iganci JRV** (2018) Endemic plants from the southern Brazilian highland grasslands. *Rodriguésia* 69 (2): 429–440.
- Maack R** (2012) *Geografia física do estado do Paraná*. Universidade Estadual de Ponta Grossa, Ponta Grossa, Brazil, 526 pp.
- Martinelli G** (2007) Mountain biodiversity in Brazil. *Brazilian Journal of Botany* 30 (4): 587–597. <https://doi.org/10.1590/S0100-84042007000400005>
- Martins-Ramos D, Chaves CL, Bortoluzzi RLC, Mantovani A** (2011) Florística de Floresta Ombrófila mista altomontana e de campos em Urupema, Santa Catarina, Brasil. *Revista Brasileira de Biociências* 9 (2): 156–166.
- Mathias ME, Constance L** (1951) Supplementary notes on South American *Hydrocotyle*. *Bulletin of the Torrey Botanical Club* 78 (4): 300–309.
- Mathias ME, Constance L, Araujo D** (1972) Umbelíferas. In: Reitz PR (Ed) *Flora ilustrada catarinense. Herbário 'Barbosa Rodrigues'*. Itajaí, Brazil, 1–205.
- Meireles LD, Kinoshita LS, Shepherd GJ** (2014) Composição florística da vegetação altimontana do distrito de Monte Verde (Camanducaia, MG), Serra da Mantiqueira Meridional, sudeste do Brasil. *Rodriguésia* 65 (4): 831–859.
- Mocochinski AY, Scheer MB** (2008) Campos de altitude na Serra do Mar paranaense: aspectos florísticos. *Floresta* 38 (4): 625–640.
- Nery EK, Fiaschi P** (2019) Geometric morphometrics dismiss the polymorphic *Hydrocotyle quinqueloba* (Araliaceae) from the Neotropics. *Systematic Botany* 44 (2): 451–469. <https://doi.org/10.1600/036364419X15561132273558>
- Nery EK, Matchin-Viera ME, Camacho O, Caddah MK, Fiaschi P** (2020) Delimiting a constellation: integrative taxonomy of a star-shaped *Hydrocotyle* species complex (Araliaceae) from the Brazilian Atlantic Forest. *Plant Systematics and Evolution* 306 (57): 1–17 <https://doi.org/10.1007/s00606-020-01682-8>
- Perkins AJ** (2020) *Hydrocotyle simulans* (Araliaceae), a new perennial species from south-eastern Australia. *Phytotaxa* 437 (2): 066–072. <https://doi.org/10.11646/phytotaxa.437>

- .2.3
- Plunkett GM, Chandler GT, Lowry II PP, Pinney SM, Sprenkle TS** (2004) Recent advances in understanding Apiales and a revised classification. *South African Journal of Botany* 70 (3): 371–381. [https://doi.org/10.1016/S0254-6299\(15\)30220-9](https://doi.org/10.1016/S0254-6299(15)30220-9)
- QGIS Development Team.** QGIS. <https://download.qgis.org/downloads/>. Accessed on: 2021-09-15.
- REFLORA.** Herbário Virtual REFLORA. <http://reflora.jbrj.gov.br/reflora/herbarioVirtual/ConsultaPublicoHVUC/ConsultaPublicoHVUC.do>. Accessed on: 2023-02-17.
- Ríos RC, Cruz VJMV,** (2021) *Triuris hyalina* Miers: first record of Triuridaceae in the southern Atlantic Forest of Paraná, Brazil. *Check List* 17 (5): 1285–1290. <https://doi.org/10.15560/17.5.1285>
- Roderjan CV, Grodzki L** (1999) Acompanhamento meteorológico em um ambiente de Floresta Ombrófila Densa Altomontana no morro Anhangava, município de Quatro Barras - PR, no ano de 1993. *Cadernos da Biodiversidade* 2 (1): 27–34.
- Ruiz-Avila RJ, Klemm VV** (1996) Management of *Hydrocotyle ranunculoides* L.f., an aquatic invasive weed of urban waterways in Western Australia. *Hydrobiologia* 340: 187–190.
- Scheer MB, Mocochinski AY** (2009) Florística vascular da floresta ombrófila densa altomontana de quatro serras no Paraná. *Biota Neotropica* 9 (2): 51–69. <https://doi.org/10.1590/S1676-06032009000200005>
- Silva DF, Ríos RC, Cruz VJMV, Souza I, Braga JMA** (2022) *Thismia cordata* (Thismiaceae), a new fairy lantern species from Brazilian Atlantic Forest. *Phytotaxa* 571 (1): 076–084. <https://doi.org/10.11646/phytotaxa.571.1.6>
- Souza I** (2021) *Thismia panamensis* (Standl.) Jonker (Thismiaceae): first record for southern Brazil. *Check List* 17 (4): 1055–1059. <https://doi.org/10.15560/17.4.1055>
- Souza I, Blum CT, Brotto ML** (2019) First record of *Gymnosiphon tenellus* (Benth.) Urb. (Burmanniaceae) in Paraná state and southern Brazil. *Check List* 15 (5): 863–866. <https://doi.org/10.15560/15.5.863>
- Souza VC, Lorenzi H** (2012) Botânica sistemática. Instituto Plantarum, Nova Odessa, Brazil, 768 pp.
- speciesLink network** (2023) <http://specieslink.net/search>. Accessed on: 2023-02-17.
- Stadt Müller T** (1987) Cloud Forests in the humid tropics: a bibliographic review. Turrialba: The United Nations University, Turrialba, Costa Rica, 81 pp.
- Thiers B** (2023) Index herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/science/ih/>. Accessed on: 2023-05-15.
- Wanderley MGL, Shepherd GJ, Melhem TS, Giulietti AM** (2005) Introdução. In: Wanderley MGL, Shepherd GJ, Melhem TS, Martins SE, Kirizawa M, Giulietti AM (Eds.) Flora fanerogâmica do estado de São Paulo online, vol. 4. Fapesp, São Paulo, Brazil, xix–xxviii.